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PROCESSOR AND DATA BUS INTERFACE ANALYSES

Dynamics Research Corporation
2900 Presidential Drive
Fairborn, Ohio   45324

December 1987

Final Report for Period April 1985 - December 1986

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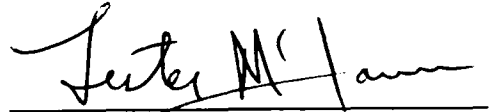
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This technical report has been reviewed and is approved for publication.

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This final report summarizes the work accomplished under the Processor and Data Bus Interface Analyses Contract Statement of Work in support of the AFWAL Avionics Laboratory for the contract period 29 April 1985 to 31 December 1986.

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This final report provides a summary of work accomplished under the Processor and Data Bus Interface Analyses S.O.W. Task, as well as other subtasks in support of the AFWAL Avionics Laboratory for the contract period 29 April 1985 to 31 December 1986. The report, which is in five parts, outlines the objectives, achievements and conclusions of each of the following contract basic tasks and subtasks:

1. Processor and Data Bus Interface Analyses - General Support Task, 26 April 1985,

2. VHSIC 1750A Computer Fault Logging Requirements Analysis subtask, 24 Feb 1986,

3. Logistics Assessment Work Station (LAWS) Supportability Analysis of the VHSIC 1750A Computer subtask, 26 June 1986,

4. Operational Avionics Data for Pave Pillar Correlation subtask, 2 May 1986, and

5. Change One to the Contract S.O.W., Task No. 4, 19 June 1986.

These tasks were performed for AFWAL/AAAS-3, AFWAL/CDLA and AFWAL/FIX under contract number N00140-82-G-BZ99/Y306 and contract modification number Y30601.

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Task Title: Processor and Data Bus Interface Analysis - General
Support

Objective: The objectives of the basic statement of work
(S.O.W.) tasks were as follows:

1.   Collect and analyze VHSIC 1750A computer interface
requirements data and technical design data of the two
V1750A contractors.

2.   Support the design review of each V1750A computer con-
tractor.

3.   Prepare a master schedule for the V1750A computer pro-
gram to include hardware availability.   Identify
schedule incompatibilities and cost-effective schedule
modifications.

4.   Review and compare LCC approaches and logistics support
concepts for compatibility with ATF objectives.

Specifics: A total of 30 V1750A contractor documents were
reviewed and comments provided to the Program Office in support
of both the SRR and PDR.   A listing of documents reviewed
follows:

TRW Documents Reviewed

1.   Logistics Support Analysis (LSA) Plan

2.   Maintainability Program Plan

3.   Reliability Program Plan

4. Reliability Mathematical Model & Report

5. Use Study Report

6. Comparative Analysis Report

7. Technological Opportunities Report

8. Parts Selection, Control & Standardization Program Plan

9. Failure Mode, Effects & Critical Analysis (FMECA) Report

10. Maintainability Prediction Report

11. LSA Reports

12. Configuration Management Plan

13. Quality Assurance Environmental Test Report

Westinghouse Documents Reviewed

1. LSA Plan

2. Maintainability Program Plan

3. Reliability Program Plan

4. Use Study Report

5. FMECA Report

6. Maintainability Prediction Report

7. Supportability Related Design Factors

8. Comparative Analysis Study

9. Standardization Study

10. Technological Opportunities Study

11. Design to Cost/Life Cycle Cost Document

12. Functional Analysis

13. Supportability Final Analysis

14. Quality Assurance Environmental Test Plan

15. Reliability Math Models

16. Configuration Management Plan

17. Users Manual for the V1750A Computer DTC/LCC Model

Documents Delivered: The following documents were delivered for these tasks under CDRL Sequence Numbers A003 and A007:

a. Draft Program Schedule, Report No. E-10089U, 14 June 1985

b. Program Schedule, Report No. E-10370U, 30 August 1985

c. Review of V1750A SRR Documentation supplied by TRW, Report No. E-10304U, 19 August 1985

d. Review of V1750A SRR Documentation supplied by Westinghouse, Report No. E-10362U, 28 August 1985

e. VHSIC 1750A PDR-TRW Documentation Review, Report No. E-10690U, 22 November 1985

f. Review of Westinghouse User's Manual for the VHSIC 1750A Computer Design to Life Cycle Cost Model, Report No. E-19404U, 9 September 1985

g. VHSIC 1750A PDR Westinghouse Documentation Review, Report No. E-10748U, 9 December 1985

Subtask Title: VHSIC 1750A Computer Fault Logging Requirements
Analysis.

Objective: The objective of this task was to investigate and
identify fault logging requirements for the VHSIC 1750A computer
modules as part of the logistics supportability assessment during
the development program.

Specifics: The following actions were taken to provide the
baseline data from which a methodized approach was developed for
utilization of the VHSIC 1750A computer in a generic environment:

    a.   Interface with AFLC managers who maintain current
       avionics computer systems;

    b.   Interface with the development contractors for the
       VHSIC 1750A computer;

    c.   Research of technical reports developed in support of
       the VHSIC technology;

    d.   Development of an application scenario, operational
       concept and utilization concept for the VHSIC computer.

Conclusions/Recommendations: Based upon the results of the
requirements analysis of the VHSIC 1750A computer, the following
issues were summarized in the report:

    a.   Current maintenance data codes used for avionics sys-
       tems appear to be adequate, however, a standard VHSIC
       1750A computer Work Unit Code should be developed for

identification of the computer across various weapon systems' avionics systems;

b. Development of a Testability Figure of Merit Model for use in concept evaluation for systems that will utilize the VHSIC 1750A computer to assist in formulating standardized maintenance concepts for life cycle cost estimating;

c. Test capability for the VHSIC 1750A computer maintenance at depot facilities should include both a static and dynamic test potential for full environmental testing of all end item usage;

d. Standard VHSIC 1750A computer technical orders should be developed for all systems that utilize this computer.

Document Delivered: The following document was delivered for this subtask under contract CDRL Sequence Numbers A003/A004/A005: Technical Report No. E-12239-U, VHSIC 1750A Computer Fault Logging Requirements Analysis, 30 October 1986.

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Subtask   Title: Logistics   Assessment   Work   Station   (LAWS)
Supportability Analysis of the VHSIC 1750A Computer.

Objective: The   primary objective of this task was to   evaluate
the   supportability   of   the VHSIC 1750A   computer   in   light   of
various   design   alternatives and to identify those areas in   the
designs   that   could significantly affect   supportabilty   of   the
computer   in terms of R&M 2000 goals.   LAWS was used to   perform
the quantitative analysis and to display the results.   A second-
ary objective was to access the availability of contractor design
data to perform the LAWS analysis and to make recommendations for
a data collection package for future LAWS applications.

Specifics: The   methodology   utilized for   this   supportability
analysis involved the following:

    a.   investigation of the technology;

    b.   identification of operational goals;

    c.   identification   of   supportability   characteristics   in
        terms   of   the ten Integrated Logistics   Support   (ILS)
        elements;

    d.   assessment of combat supportability in terms of the ILS
        impact on each of the R&M 2000 goals;

    e.   effect   of enhanced VHSIC 1750A computer module   relia-
        bility on all measures of the R&M 2000 goals;

    f.   impact   of   VHSIC 1750A computer system   complexity   on
        maintenance and support requirements;

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g.   evaluation of any life cycle cost high drivers;

h.   impact of two level maintenance support;

i.   sensitivity analyses involving what-if conditions for the alternate design.

Findings: The findings of the quantitative analysis utilizing LAWS methodology indicated the following:

a.   predicted reliability levels of the computer modules is well within the limits necessary for a two level maintenance support concept;

b.   many issues identified as potential R&M 2000 drivers were found to be insensitive to the measures of performance and supportability once these issues were quantified.   Again, the high predicted reliability of the VHSIC 1750A computer was the main reason.

Conclusions/Recommendations: Based on the results of the qualitative and quantitative supportability analysis of the VHSIC 1750A computer, the following issues were summarized in the report:

a.   Reliability of the proposed computer design is high enough to require minimal levels of supportability during peacetime and over a 30-day war.   Significant degradation of this design reliability would have to occur to adversely impact combat capability.

b.   Life cycle cost of the VHSIC 1750A computer will be considerably lower than comparison systems.   This can be attributed to the high reliability along with a two level maintenance concept.

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c. On-equipment maintenance cost for the computer modules was identified as being sensitive to degraded reliability.

Based upon lessons learned during the data acquisition process, a Data Collection Guide was developed for future applications of LAWS supportability analyses within the AFWAL Avionics Laboratory.

Documents Delivered: The following documents were delivered for this subtask under contract CDRL sequence numbers A003 and A010:

a. LAWS VHSIC 1750A Supportability Analysis, Technical Report No. E-12423-U, dated 9 Jan 1987;

b. LAWS Data Collection Guide, Report No. E-12420-U, dated 31 December 1986.

Subtask Title: Operational Avionics Data for Pave Pillar
Correlation

Objective: The   primary objective of this task was to develop a
data base containing F-16 avionics systems reliability data   that .
could   be   used   to correlate to the   new   Pave   Pillar   Avionics
Architecture under development by the AFWAL Avionics Laboratory.
A   secondary   objective was to investigate the reliability rela-
ionships of components within a Pave Pillar type integrated
avionics   system architecture in order to define an approach   for
modeling   a   fault   tolerant system with   "graceful   degradation"
failure characteristics.

Specifics: The   Logistics   Support Analysis   (LSA)   methodology
requires creation of a yardstick to measure the supportability of
a   proposed design.   This yardstick is defined as   the   baseline
comparison   system   (BCS) and is used throughout the   development
process   to measure supportability of a new   design.   This   task
utilized   the F-16 avionics system as the BCS for data base defi-
nition.   The approach taken to produce this supportability analy-
sis tool involved the following steps:

    a.   data identification

    b.   analysis specification

    c.   data collection and data base creation

    d.   analysis tool development

The data required for the statistical comparison was acquired from the F-16 Centralized Data System (CDS) on two levels: (1) the weapon system, and (2) the avionics subsystems and components. Using the acquired CDS data, an operational MTBF data base was created for the statistical comparison tool--a micro-computer program.

Conclusions/Recommendations: The technical approach outlined in the report is consistent with the methodology of LSA. The analysis tool will allow users to exercise multiple options for supportability assessment.

The reliability modeling investigation identified the necessary inputs to a LAWS-type supportability model to allow the concept of system fault tolerant redundancy to be incorporated.

Documents Delivered: The following documents were delivered for this subtask under contract CDRL sequence numbers A010 and A003/A004/A005:

   a.   Operational Avionics Data for Pave Pillar Correlation, Technical Report No. E-12428-U, dated 31 December 1986.

   b.   Reliability Modeling Investigation, Technical Report No. E-12381-U, dated 31 December 1986.

Subtask Title: Change One to the Contract S.O.W.,   Task No. 4,
Modification Number Y30601 (see note below).

Objective: The objective of this subtask was twofold: (1)
develop a Logistics Assessment Methodology Prototype (LAMP)   that
incorporates the goals of the R&M 2000 Action Plan and Integrated.
Logistics Support into a supportability assessment framework
which effectively implements LSA within the   AFWAL environment,
and (2)   develop a Logistics Assessment Work Station   (LAWS),   a
decision support tool which quantitatively implements   the   LAMP
methodology.

Achievements/Conclusions: A discussion of the LAMP/LAWS subtask
is not included within this report since the project results were
documented in the DRC reports listed here as references.

Report Title	Report Number	Date
Quick Look Logistics Analysis - Technical Report	E-10743-U	31 Jan 1986
LAWS Functional Description	E-10929-U	4 Apr 1986
LAWS Test Plan	E-11599-U	23 May 1986
LAWS Users Manual	E-11776-U	18 July 1986
LAWS Test Analysis Report	E-11779-U	15 Sep 1986
LAWS Final Report	E-11777-U	6 Oct 1986

Note: All LAMP/LAWS work accomplished under contract modifica-
tion No. Y30601 was sponsored and funded by AFWAL/FIX.

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